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FORAMINIFERA OF THE PALEOGENE AND NEOGENE OF THE AUMINZATAU MOUNTAINS (CENTRAL KYZYLKUM)

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Abstract:

This article is the result of a study of Paleogene and Neogene boundary deposits based on the foraminifers of the Auminzatau Mountains. The urgency of setting these works was due to the fact that the Oligocene-Early Miocene sediments due to the paucity of faunal remains in them, did not have sufficient paleontological substantiation.

The paleontological material collected and studied by the author of the article made it possible to determine the boundary between the Paleogene and Neogene based on foraminifers. The need to subdivide the Oligocene-Early Miocene deposits on the territory of the Auminzatau Mountains (Central Kyzylkum) is dictated by the fact that the current state of the validity of their subdivision and correlation does not provide the necessary accuracy of comparison with the International Stratigraphic Scale.

Keywords: foraminifera, Kultaban, Sarbatir, Agitmina, Burdigalian Formations, Bartonian, Rupelian, Chattian, Aquitanian Stages.

INTRODUCTION

Paleogene and Neogene sediments in the Central Kyzylkum are uncovered by boreholes and known in outcrops bordering the Bukantau, Kuljuktau, Auminzatau, Beltau mountains, and etc.

The scientists studied them during the geological surveying in the 1970s and 1990s (Ya.B. Aisanov et al., K.K Pyatkov et al., A.S. Buharin et al., A.V. Tolokonnikov et al., V.M. Zheleznov et al., H.S. Sarbaev et al.) and during the paleontological stratigraphic works (R.K. Makarova, E.M. Tsatsir, I.S. Suleymanov, A.A. Abdusamatov, N.V. and others).

During 2018-2019, the detailed paleontological studies of the boundary layers of Paleogene and Neogene in the area of the Sarbatir well (the Auminzatau foothills) have found a new paleontological material on the fauna of foraminifera, which allows to clarify the level of this boundary in the region. The studied area showed that the boundary interval was located in the Sarbatir Formation underlying by the KultabanP_2^2. According to the faunistic and lithofacies features, the Kultaban (Bartonian Stage), Sarbatir (Rupelian, Chattian, Aquitanian and Burdigalian Stages) Formations are distinguished in the studied area (Fig. 1). The Sarbatir Formation is divided into three benches. At the base of the third (III) bench, the boundary between the Paleogene and Neogene systems is drawn.

The Kultaban Formation P_2^2 bkl was first identified by R.K. Makarova, E.F. Tsatsir, (Stratigraphic dictionary, 2001, p. 274) in the Central Kyzylkum. The stratotypeis located in the Kultaban tract, 7 km to the east ofthe Tamdykuduk well. In the stratotype, the formation is represented by clays of greenish-gray, bluish-green, aleuritic, carbonate in the lower part, and noncarbonate in the upper one. The thickness is up to 210m. The rocks contain foraminifera –*Anomalina venesuelana* Nutt., *Haplophragmoides orfaensis* Rod., *Trochammina masini* Sub., *Pseudohastigerina sharkriverensis* (Berg. et Olss.), *Acarinina rotundimarginata* Subb., *Uvigerina costellata* Moroz., *Asianella vialovi* N. Byk., *Cribrononion rischtanicum* N. Byk.; marine bivalve molluscs– *Nuculana santasica* Jark., *Bathyarca rubastschaica* Korob., *Marcia (Mercimonia) gasliensis* Korob. et Makar., *Lucina menardi* Desh., *Pitar nitida* Desh., *Ostrea simplex* Desh.; nannoplankton of the NP 16-17 zone *Discoaster bifax*, *D. saipanensis*. A complex of organic remains is characteristic of the Bartonian Stage.

In the Sarbatir section, the formation is represented by the upper part and consists of dark gray and light gray clays with interlayers of gray-white gypsum with a brownish hue. The thickness of the formation in the studied section is 15 m.

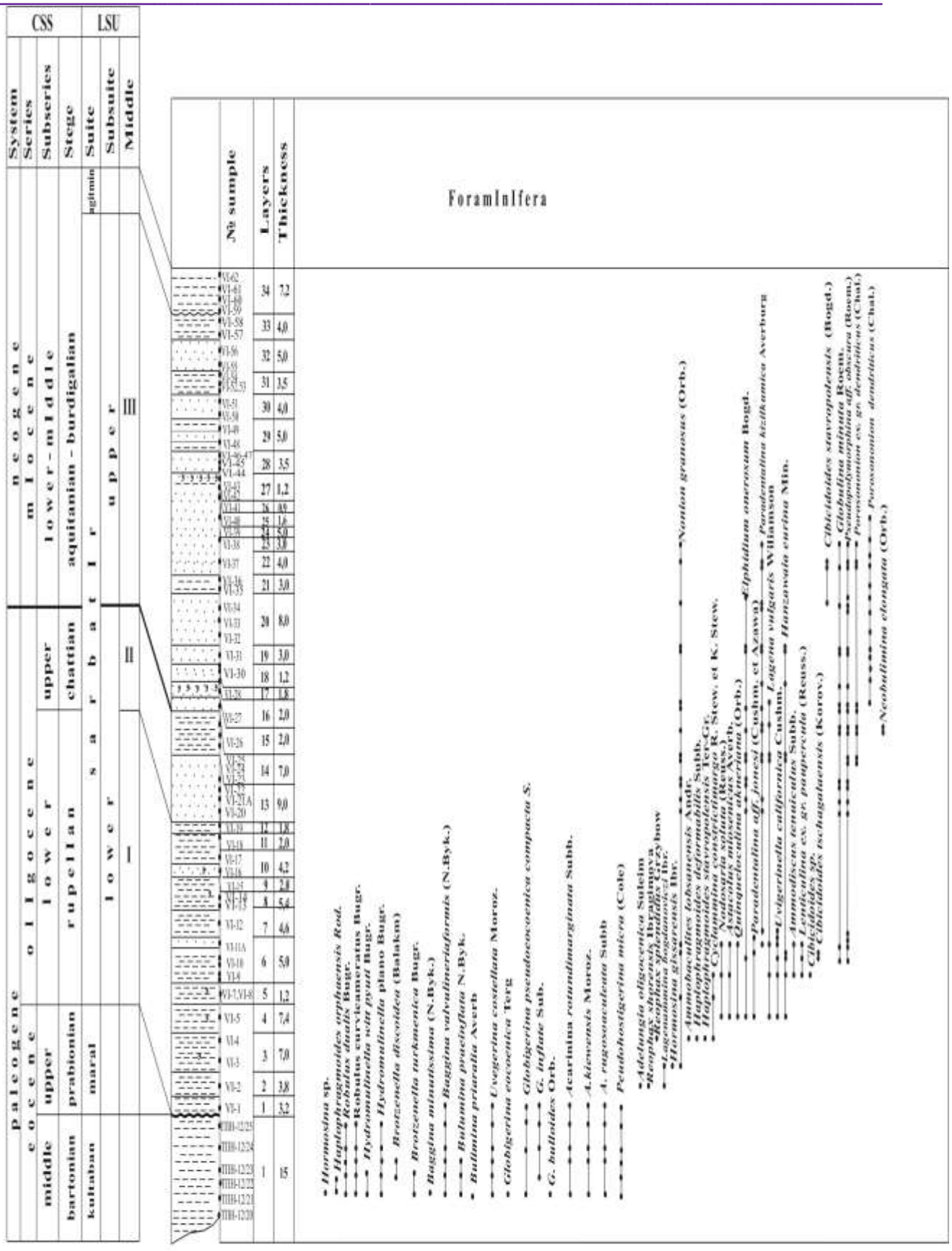

Fig.1. Lithologic-stratigraphic section VI along the Kultabanian (P_2^3b *kl*), Sarbatyr (P_3-N_1^1 *sr*) and Agitminian (N *ag*) suites in the area of the Sarbatyr well on the foothills of Auminzatau.
Scale 1:1000

The clays of the upper part of the Kultaban Formation are characterized by benthic foraminifera: *Hormosina sp.,*Haplophragmoides orfaensis* Rod.,**Robulis dualis* Burg., **Robulus curvicameratus* Bugr*., Hydromylinella wittpyuti* Bugr.,**Hydromylinella plano* Bugr.,**Brotzenella turkmenica* Bugr.,**Brotzenella discoidea* (Balakhm.),**Baggina valvulineriaformis* N.Byk., *Baggina minutissima* (N. Byk.), **Falsoplanulina ammophila* (Gumb.), *Falsoplanulina captiosa* Bugr,**Bulimina praeinflata* N.Byk*., Bulimina priaralia* Averb., **Uvigerina costellata* Moroz., planktonic foraminifera: *Globigerina eocaenica* Ter-Gr, *Globigerina pseudoeocenica compacta* Suleym., **Globigerina inflate* Sub., *Globigerina bulloides* Orb., **Acarinina rotundimarginata* Subb*., Acarinina kiewensis* Moroz., **Acarinina rugosoaculeata* Subb.,**Pseudohastigerina micra* (Cole), characteristic of the tops of the Bartonian Stage. The noted species were found in coeval sediments of the southern regions of Russia (Fig. 1, Table 1).

In the studied section, the Priabonian sediments are eroded (Fig. 1).

The Sarbatir Formation P_3-N_1^1*sr*, represented by shallow red-colored sediments of the Oligocene-Early Miocene, was first identified by M.N. Gramm in 1959 in the Central Kyzylkum [4]. In the Central Kyzylkum, two sub-formations are often distinguished in the formation section. The lower part is composed mainly of clays, while the upper one –of sands and sandstones. The boundary between the Oligocene and Miocene was tenuously drawn inside the Upper Sarbatir Formation. The boundary contains marine bivalve molluscsin the lower part –*Chlamys bifida* Munst., *Ch. bifida lucida* Goldf., *Miocardiopsis ustjurtensis* Iljina, *Calista dubia* Holzl., *Nucula orbignyi* Glib., *N. peregrine* Desh., *Garian gusta* Phil.; characteristic of the Oligocene; foraminifera – *Cyclammina placenta* (Reuss.), *Haplophragmoides latidorsatus* (Bronn.), *Caucasina schischkinskyae* Sam., *Cribrononion krimholsy* Balakhm., *Cibicides ornatus* Bogd.; in the upper part – *Nucula comta* Goldf., *Nuculana gracilis* Desh., *Musculus sternbergensis* Ander., *Cardiuma bundans* Liver., *C. serogosicum* Nossov, *Siligua bavarica* Gümb., *Cyrtodaria angustaparva* Speyer., *Cyprina rotundataelliptica* Speyer., *Cardium levinae* Merkl., *Isocardia burdigalensis* Desh., *Corbula helmerseni* Mikhail., *Lentidium kuzhasaica* Merkl., typical of the Chattian Stage (upper Oligocene); foraminifera –*Pararotalia canui* (Cushm.), *Discorbis propingus* (Roem.), *Elphidium subnodosum* (Roem.), *E. heltermanni* Hand., *Dentalina solute* Orb., *Purrulina fusiformis* (Roem.), *Porozononion dendriticus* (Chal.). The foraminifera complex is represented by forms characteristic of the upper Oligocene and the lower Miocene (*Porozononion dendriticus* (Chal.)). It lies with erosion at different horizons of the Eocene, with erosion overlaps the Agitmina Formation (the upper part of the Rupelian Stage, the lower part of the Burdigalian Stage). [1,4,5]

Table 1
STRATIGRAPHIC RANGE OF FORAMINIFERA IN THE SARBATIR FORMATION AND ITS CORRELATION WITH COEVAL SEDIMENTS OF CRIMEA, CAUCASUS

	Species of foraminifera	Northeast Auminzataufoothills. Sarbatir well					Southern regions of Russia and adjacent territories (Crimea, Caucasus) Bugrova, 2005				
		Paleogene			Neogene		Paleogene			Neogene	
		Eocene	Oligocene		Miocene		Eocene	Oligocene		Miocene	
		middle	lower	upper	lower		middle	lower	upper	lower	
		Bartonian	Rupelian	Chattian	Aquitanian	Burdigalian	Bartonian	Rupelian	Chattian	Aquitanian	Burdigalian
№	1	2	3	4	5	6	7	8	9	10	11
1	*Lagenammina bogdanoviczi* Ibrag.		+								
2	*Ammodiscus tenuiculis* Subb.		+					+	+		
3	*Reophax shorsuensis* Ibragimova		+								
4	*Reophax splendidus* Grzybow		+								
5	*Haplophragmoides deformabilis* Subb. et Ter.-Gr.		+					+			
6	*Haplophragmoides orfaensis* Rod.	+					+				
7	*Haplophragmoides stavropolensis* Ter-Grig.		+					+		+	
8	*Hormosina gusanensis* Ibrag.		+								
9	*Adelungia oligocenica*		+								

	Suleim.										
10	*Ammobaculites lobsanensis* Andr.		+					+	+		
11	*Cyclammina constrictimargo*R.Stew. et K.Stew.		+					+		+	
12	*Quinqueloculina akneriana* (Orb.)		+								
13	*Nodosaria solute* (Reuss.)		+								
14	*Lagena vulgaris* Williamson		+	+	+						
15	*Lenticulina ex.gr. paupercula*(Reuss.)		+								
16	*Robulis dualis* Burg.	+					+				
17	*Robulus curvicameratus* Bugr.	+					+				
18	*Astacolus miocenicus* Averb.		+								
19	*Paradentalina jonesi* (Cushm. et Ozawa)		+	+	+						
20	*Paradentalina kizilkumica* Averburg.		+	+	+						
21	*Pseudopolymorphina aff. obscura* (Roem.)		+	+	+	+					+
22	*GlobulonaminutaRoem.*		+	+	+						
23	*Baggina valvulineriaformis* N.Byk.	+					+				
24	*Baggina minutissima* (N.Byk.)	+									
25	*Cibicidoides tschagalaensis* (Korov.)		+				+				
26	*Cibicidoides stavropolensis* (Bogd.)				+	+				+	+
27	*Cibicidoides sp.*		+								
28	*Brotzenella discoidea* (Balakhm.)	+					+				
29	*Brotzenella turkmenica* Bugr.	+					+				
30	*Hanzawaia eurina* Min.		+	+	+						
31	*Nonion granosus* (Orb.)		+	+	+						
32	*Porosononion dendriticus* (Chal.)				+	+				+	+
33	*Porosononion ex gr. dendriticus* (Chal.)			+	+	+					+
34	*Elphidium onerosum* Bogd.		+	+	+	+		+	+		+
35	*Bulimina praeinflata* N.Byk.	+					+				
36	*Bulimina priaralia* Averb.	+									
37	*Neobulimina elongata*			+							

7	(Orb.).										
38	*Caucasina splendida* Rod.						+				
39	*Uvigerinella californica* Cushm.		+						+	+	
40	*Uvigerina costellata* Moroz.	+					+				
41	*Hydromylinella plano* Bugr.	+					+				
42	*Hydromylinella wittpyuti* Bugr.	+									
43	*Falsoplanulina ammophila* (Gumb.)	+					+				
44	*Falsoplanulina captiosa* Bugr.	+									
Planktonic foraminifera											
45	*Globigerina eocaenica* Ter-Gr	+									
46	*Globigerina pseudoeocenica compacta* S.	+									
47	*Globigerina inflate* Sub.	+					+				
48	*Globigerina bulloides* Orb.	+									
49	*Acarinina rotundimarginata* Subb.	+					+				
50	*Acarinina kiewensis* Moroz.	+									
51	*Acarinina rugosoaculeata* Subb.	+					+				
52	*Pseudohastigerina micra* (Cole).	+					+				

In the Sarbatir section, the Sarbatir Formation is represented by brown clays, with a yellowish-cherry hue, slightly sandy; gray sands, variegated with rare interlayers of shell-sandstone. The thickness is 125.3 m. The formation with erosion lies atKultaban and is divided into three benches (Fig. 1).

I-the lower bench is represented by brown clays with a gray-cherry hue, with interlayers of grayish-yellow sandstones with a greenish hue. The bench thickness is 47.6 m.

The foraminifera are identified from the clays of the lower part of the first bench *Lagenammina bogdanowizci* Ibr., *Reophax splendidus* Grzybow, *Reophax shorsuensis* Ibragimova, **Ammobaculites lobsanensis* Andr.,**Ammodiscus tenuiculus* Subb.,**Cyclammina constrictimargo* R.Stew. et K.Stew., *Hormosina gusarensis* Ibr., **Haplophragmoides deformabilis* Subb. et Ter.-Gr.,**Haplophragmoides stavropolensis* Ter.-Gr., *Lagena vulgaris* Williamson, *Nodosaria solute* (Reuss), *Lenticulinaex. gr. paupercula* (Reuss), *Quinqueloculina akneriana* (Orb.), *Astacolus miocenicus* Averb. (msc), *Adelungia oligocenica* Suleim., *Heterolepa documentata* (N.Byk.), *Pseudopolymorphina aff. obscura* (Roem), *Paradentalina jonesi* (Cushm. et Azawa), *Paradentalina kizilkumica* Averburg, *Globulina minuta* Roem., *Pseudopolymorphina aff. obscura* (Roem.), *Cibicidoides tschagalaensis* (Korov.), *Cibicidoides sp., Hanzawaia eurina* Min., *Nonion granosus* (Orb.), *Uvigerinella californica* Cushm., **Elphidium onerosum* Bogd. and others, characteristic of the Rupelian Stage of the Lower Oligocene. A biofacies analysis of foraminifera of the Sarbatir Formation at the Auminzatau foothills, the area of the Sarbatir well, was compiled.

By lithological-stratigraphic section. The noted species were found in coeval sediments of the southern regions of Russia (Fig. 1, Table 1. 2)

Table 2
Biofaciesanalysis of foraminifera of the Sarbatir Formation at the Auminzatau foothills, the area of the Sarbatir well. Lithological-stratigraphic section - VI (sample 1-21)

System	Series	Subseries	Stage	m/f Zone	Name of species	Salinity		Temperature		Behaviour		Habitant
						Stenohaline	Euryhaline	Stenothermic	Eurythermic	Benthic	Planktic	
1	2	3	4	5	6	7	8	9	10	11	12	13
Paleogene	Oligocene	Lower	Rupelian	Cyclamminaconstrictimargo = Spiroplectamminaoligocenica	*Lagenammina bogdanowizci* Ibr.	+		+		+		The upper part of the bathyal zone (200-750 m)
					Reophax splendidus Grzybow	+		+		+		Sublittoral zone (50-200 m)
					Reophax shorensis Ibragimova.	+		+		+		
					Ammobaculites lobsanensis Andr.	+		+		+		
					Ammodiscus tenuiculus Subb.	+		+		+		
					Cyclammina constrictimargo R. Stew. et K. Stew.	+		+		+		The lower part of the bathyal zone (750-2000 m)
					*Cyclammina turosa*Ter – Grig.	+		+		+		
					Cyclammina sp.	+		+		+		
					Hormosina gusarensis Ibr.	+		+		+		Sublittoral zone (50-200 m)
					Haplophragmoides deformabilis Subb. et Ter – Gr.	+		+		+		
					Haplophragmoides stavropolensis Ter – Gr.	+		+		+		
					Lagena vulgaris Williamson.	+		+		+		
					Lenticulina ex. gr. paupercula (Reuss)	+		+		+		
					*Astacolus miocenicus*Averb. (msc)	+		+		+		
					Astacolus sp.	+		+		+		
					Adelungia oligocenica Suleim.	+		+		+		
					Nodosaria solute Reuss.	+		+		+		
					Heterolepa documentata (N. Byk.)	+		+		+		
					Globulina minuta Roem.	+		+		+		
					Paradentalina kizilkumica Averburg	+		+		+		
					Paradentalina aff jonesi (Cushm. et Azawa)	+		+		+		
					Pseudopolymorphina aff. Obscura (Roem)	+		+		+		
					Uvigirinella californica Cushm.	+		+		+		
					Uvigerina sp.	+		+		+		

					Quinqueloculina akneriana (Orb.)	+		+		+		
					Cibicidoides tschagalaensis (Korov.)	+		+		+		
					Elphidium onerosum Bogd.		+	+		+		
					Hanzawaia eurina Min.	+		+		+		
					Nonion granosum Bogd.		+	+		+		

CONCLUSION. The presence of foraminifera in Rupelian sediments indicates marine habitat conditions. The complex is represented by benthic forms. Sand forms of species were found: Lagenammina, Ammodiscus, Ammobaculites, Reophax, Cyclammina and calcareous Pseudopolymorphina, Hormosina, Hanzawaia, Astacolus, Cibicidoides, Nonion, Elphidium. Most of the foraminifera found are stenohaline. Sea water contains a large amount of dissolved salts, including calcium carbonate, from which shells of secreting foraminifera are mainly built and which is often cement ofarenaceousforms. The total concentration of salts in ocean basins and open seas is approximately 34-35‰. Only species: Nonion, Elphidium were competent in case of wide salinity excursions. The met forms in the Lower Oligocene are stenothermic represent 2.5–8 °. The sand forms Cyclammina, Lagenammina lived in the lower part of the bathyal zone at a depth of 750-2000m. Only species: Ammodiscus, Reophax lived in the sublittoral zones at a depth of 50-200m. Calcareous forms of foraminifera lived in sublittoral zones at a depth of 50-200m.

II-middle bench (the thickness is 16 m), is represented by: the lower layers – sands of gray-greenish-yellowish, fine-grained polymict with thin layers (3-5 cm) of cherry clay; the upper layers are clays, spotted, yellow-cherry, with a greenish hue. From this bench, foraminifera were identified: *Paradentalina kizilkumica* Averburg, *Paradentalina jonesi* (Cushm. et Ozawa), *Pseudopolymorphina aff. Obscura* (Roem.), *Lagena vulgaris* Williamson., *Globulina minuta* Roem., *Hanzawaia eurina* Min., *Porosononion ex. gr. dendriticus* (Chal.), *Nonion granosus* (Orb.), **Elphidium onerosum* Bogd., *Neobulimina elongate* (Orb.). Species characterized the Chattian Stage of the Upper Oligocene. A biofacies analysis of foraminifera of the SarbatirFormation at the Auminzatau foothills, the area of the Sarbatir well, was compiled. The marked form is found in coeval sediments of the southern regions of Russia (Table 1. 3).

III-bench. The base of the bench is composed of gray sands with a greenish hue, shell-sandstone with casts of bivalve molluscs; sands, sandstones, gray-yellow, variegated with interlayers of brown cherry clays lie above. The thickness is 61.7 m. This part of the section contains foraminifera: *Lagena vulgaris* Williamson, *Pseudopolymorphina aff. obscura* (Roem), *Paradentalina jonesi* (Cushm. et Azawa), *Paradentalina kizilkumica* Averburg, *Globulina minuta* Roem.,**Cibicidoides stavropolensis* (Bogd.), *Cibicidoides aff. speciosus* (Cush. et. Renz.), *Hanzawaia eurina* Min., **Elphidium onerosum* Bogd., *Nonion granosum* Bogd., *Porosononion ex gr. dendriticus* (Chal.), *Porosononion dendriticus* (Chal.), *Elphidium onerosum* Bogd. Typical for the Late Oligocene and Early Miocene *(Porosononion dendriticus* (Chal.), *Cibicidoides stavropolensis* (Bogd.)) of the Aquitanian and lower parts of the Burdigalian Stages. A biofacies analysis of foraminifera of the Sarbatir Formation on the Auminzatau foothills, the area of the Sarbatir well, was compiled. Similar species were found in Aquitanian and Burdigalian sediments of the southern regions of Russia (Fig. 1, Table 1. 4).

In the upper part of the bench, sands, sandstones, clay are light-gray, variegated, not containing foraminifera. We have conventionally classified these sendiments to the tops of the Burdigalian Stage.

The total thickness of the Sarbatir Formation is 147.5 m.

Table 3

Biofaciesanalysis of foraminifera of the Sarbatir Formation, Auminzatau foothills, Sarbatir well area. Lithological-stratigraphic section – VI (sample 21A-24)

System	Series	Subseries	Stage	m/f Zone	Name of species	Salinity		Temperature		Behaviour		Habitant
						Stenohaline	Euryhaline	Stenothermic	Eurythermic	Benthic	Planktic	
1	2	3	4	5	6	7	8	9	10	11	12	13
Paleogene	Oligocene	Upper	Chattian		*Pseudopolymorphina aff. obscura* (Roem)	+		+		+		Sublittoral zone (50-200 m)
					Paradentalina kizilkumica Averburg	+		+		+		
					Lagena vulgaris Williamson.	+		+		+		
					Globulina minuta Roem.	+		+		+		The lower part of bathyal zone (750-2000
					Hanzawai aeurina Min.	+		+		+		Sublittoral zone (50-200 m)
					Nonion granosum Bogd.		+	+		+		
					Porosononion ex. gr. Dendriticus (Chal.)		+	+		+		
					Elphidium onerosum Bogd.		+	+		+		
					Neobulimina elongate (Orb.)	+		+		+		

CONCLUSION. In the Upper Oligocene (Chattian Stage), there are mainly benthic foraminifera. Almost all the forms found are stenothermic 2.5–8º, stenohaline with salinity of 31.5–34.5% o. The foraminifera complex lived in the sublittoral zone at a depth of 50–200 m, and the specie Globulina lived in the bathyal zone of 275-1800 m; the temperature is 2.50-80^0.

Biofaciesanalysis of foraminifera of the Sarbatir Formation, Auminzatau foothills. Lithological-stratigraphic section - VI (sample 25-37)

System	Series	Subseries	Stage	m/f Zone	Name of species	Salinity		Temperature		Behaviour		Habitant
						Stenohaline	Euryhaline	Stenothermic	Eurythermic	Benthic	Planktic	
1	2	3	4	5	6	7	8	9	10	11	12	13
Neogene	Miocene	Lower	Aquitanian	Porosononiondendricus	*Pseudopolymorphina aff. obscura* (Roem)	+		+		+		Sublittoral zone (50-200 m)
					Paradentalina kizilkumica Averburg	+		+		+		
					Paradentalina jonesi (Cushm. et Azawa)	+		+		+		
					Lagena vulgaris Williamson.	+		+		+		

					Globulin aminuta Roem.	+		+		+		The lower part of the bathyal zone (750-2000 m)
					Nonion granosum Bogd.		+	+		+		Sublittoral zone (50-200 m)
					Porosononion dendriticus (Chal.)		+	+		+		
					Cibicidoides stavropolensis (Bogd)	+		+		+		
					Elphidium onerosum Bogd.		+	+		+		
					Hanzawaia eurina Min.	+		+		+		

CONCLUSION. The presence of foraminifera in Aquitanian sediments indicates marine habitat conditions. The complex is represented by the benthic forms. Almost all the forms found are stenothermic 2.5-8º. Foraminifera lived in the basin are stenohalinewith salinity less than 33.5-34.5% o. Only species: Nonion, Porosononion, Elphidium are euryhaline, and were competent in case of wide salinity excursions. Foraminifera lived in the sublittoral zone at a depth of 50-200 m and only the specie Globulina lived in the bathyal zone at a depth of 275-2000 m. Nonion granosus (Orb), Porosononiondendriticus (Chal.) are constantly present in the section.

The appearance of typically Miocene forms of foraminifera in the complex allows to establish the boundary between the Paleogene and Neogene systems at the base of III bench, which is represented by fine-grained polymictsands, of greenish-gray colour. At this level, foraminifera typical of the Neogene appear –*Porosononion dendriticus* (Chal.), *Cibicidoides stavropolensis* (Bogd.), transit species of the Paleogene are found in small numbers and disappear up the section. At the boundary level in the section of the formation, a change in the lithological composition occurs. The boundary of the Aquitanian and Burdigalian Stages with organic remains is not expressed and requires further study [5].

CONCLUSIONS

The author characterized the Sarbatir Formation in the area of the Sarbatir well by benthic and planktonic foraminifera, which allows to indicate sediments of the Oligocene (Rupelian, Chattian Stages) and the Lower Miocene (Aquitanian– BurdigalianStages). The marked foraminifera complexes are compared with the coeval assemblage of the southern regions of Russia. The foraminifera boundary is established between the Paleogene and Neogene at the base of the third bench of the Sarbatir Formation.

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